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(56) Documents considered for the evaluation of patentability:

DE	27 00 145 C2
DE-AS	22 45 090
DE-AS	11 43 567
DE-OS	28 21 138
DE-OS	27 58 237
DE-OS	24 28 993
DE-OS	23 60 037
DE-OS	21 57 927
DE-OS	16 38 042
DE-OS	15 40 178
DE-GM	19 23 972
DE-GM	17 34 691
AT	3 54 551

Siemens brochure "Residual current circuit breaker SFJ" (German title: "Fehlerstrom-Schutzschalter SFJ"), order no. J21/1088, 1972

(54) Residual current circuit breaker assembly

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Description

The invention concerns a residual current circuit breaker assembly in accordance with the preamble of Claim 1.

Such a residual current circuit breaker assembly is known from the German disclosure document (Offenlegungsschrift) 24 28 993 (see patent claims 1 to 6). There, in a shared housing and connected in series, are two residual current circuit breakers, which have different rated residual currents, one of which is preferably relatively low, for example 30 mA. The advantage of this assembly lies primarily in the fact that if the protective function of the first protective switch fails, the second will most likely still have its protective functionality.

It is the task of the invention to reduce the material requirement for a residual current circuit breaker assembly of the type cited initially, in order to reduce costs and the size of the device. This task is accomplished by the characteristics described in the claim.

The elimination of the main circuit breaker summation current transformer and of the final circuit breaker-neutral conductor-(PEN)-circuit breaking contacts results in significant material savings for the manufacturer. This also solves space problems which have often occurred with the known ground fault circuit breakers due to the specified standard dimensions. The object of the claim can be advantageously extended by voltage-dependent resistors between the external conductor and ground wire for monitoring the absence of voltage on the ground wire and no provision of neutral conductor and/or PEN circuit breaking contacts with the final circuit breakers.

Monitoring the absence of voltage on the ground wire using voltage-dependent resistors located between the external conductor and the ground wire is known in connection with a residual current circuit breaker from the patent specification DE 27 00 145 C2.

Embodiments are shown in the drawings. In Fig. 1 the main circuit breaker consists only of the all-pole switching contacts (1) and the associated tripping coil RH, whereas the final circuit breakers 3a, 3b, 3c and 3d each have a dedicated summation current transformer (W1, W2, W3, etc.) with the associated tripping coils R1, R2, R3, etc. and switching contacts. The neutral conductor PEN is only connected with the main circuit breaker, since a neutral conductor voltage can practically be fed only before the main circuit breaker.

The ground wire PE branching off of the neutral conductor PEN in the residual current circuit breaker assembly ("combo-breaker" for short) can carry the full or reduced mains voltage in two ways:

1. During installation, an external line (e.g. L3) is accidentally switched with the neutral conductor PEN in front of the terminal contacts (i.e. in the direction of the mains transformer), i.e. the power line is connected to the PEN terminal of the ground fault circuit breaker and the mains PEN conductor is connected to an external conductor terminal of the ground fault circuit breaker. This can happen with the installer when connecting the combo-breaker or with the local mains installer during work on the connection. Such incorrect connection usually results from the colors used for wires, which previously were ambiguous and varied.

2. There is an interruption in the neutral conductor PEN in front of the terminal contacts of the combo-breaker (e.g. forgotten connection or a loose contact resulting from a terminal not properly secured, or a broken neutral conductor in overhead lines from a storm). The consequence of this neutral conductor interruption is that the full mains voltage will be transferred to the protective conductor for the system PE via the load resistances of the devices G1, G2, G3 and G4; i.e. all device housings carry the full mains voltage. (If a foundation ground and potential equalization line are present this erroneous voltage is in fact reduced in the vicinity but not completely eliminated. Outside of the vicinity, e.g. in the courtyard or garden, it increases with increasing distance up to the full value).

If the ground wire PE carries the mains voltage (e.g. the voltage from L3), then (in the 380/220 V mains) in the combo-breaker the PE voltage vs. L1 and PE vs. L2 is equal to 380 V. The consequence is that the voltage-dependent resistors 4b and 4c become low impedance that is conducting. Now a current, which flows back via the protective conductor PE, i.e. externally, flows through the summation current transformer of the final circuit breaker 3a. A voltage is induced in both secondary windings, which switches off the main circuit breaker 1 as well as the final circuit breaker 3a via the relay coils RH and R1. The summation current transformer W1 thus supplies the tripping energy not only for the final circuit breaker 3a, but also for the main circuit breaker 1.

If the rated residual current of each final circuit breaker is 30 mA, for example, and that of the main circuit breaker is 100 mA, then with optimal division of the circuits to the three phases a cut-out of the main circuit breaker hardly occurs if for one or more end-systems shorts to ground occur (direct contact with lines, short circuit to a conductive part in the load device G1, G2, G3 .., ground wire/external conductor switching or ground wire interruption with ground wire to external conductor contact). On the other hand, the necessary protection is most likely still provided even if the protective function of a circuit breaker fails as a result of a mechanical fault. Experience has shown that almost without exception it is mechanical faults (such as sticking of the relay anchor and blocking of the lever mechanism) that cause the protective function to be lost. The summation current transformer almost never fails.

Since the test line with the test resistor 6, which is connected in series, runs through all summation current transformers, actuating the test button P will switch off all ground fault circuit breakers. If the protective function for one of the circuit breakers has failed, it does not switch off, which can be recognized visually on the switching lever (7, 8, 9, 10 or 11 in Fig. 2).

The incorporation of several residual current circuit breakers in a single housing in accordance with the concept of the invention and the additional inclusion of the characteristics described above not only saves material, but also offers significant advantages for the installer and reduces installation errors to a large extent, which correspondingly increases the protection value:

1. The installer is relieved of the burden of correctly planning the individual circuit breaker trigger currents (rated residual currents), because an optimal design, particularly with regard to the protection of persons (such as final circuit breakers of 30 mA each and a main circuit breaker of 100 mA rated residual current) can be implemented with the pre-fabricated residual current circuit breaker assembly. The result is not only the greatest possible personal safety, but also less effort for planning as well as the avoidance of unhelpful fault shutdowns.

2. The installer requires less material, since the connection lines are eliminated for him.

3. Due to the second point, the installer also needs less work time and also must not perform the necessary testing and inspection.

4. Since the installer must do no wiring, there are also no connection errors to be made, which could lead to the endangerment of persons and/or to unhelpful fault shutdowns.

Fig. 2 shows an example of the external design embodiment of the assembly. The main circuit breaker is located in the left part of the housing. The line coming from the mains L1, L2, L3 and PEN are connected at the top left. As discussed previously, an immediate shut-down occurs if, for example, the connection wires of L3 and PEN are switched.

The switching levers 7, 8, 9, 10 and 11 can be used to turn the respective circuits on and off manually. "P" is the common test button for all ground fault circuit breakers. On the underside are the connections of the lines leading to the load system. The individual ground wires are connected to the left terminals a, b, c and d. Next to that on the right are the four connections L1, L2, L3 and N for a three-phase system, further to the right are the connections for three alternating current systems.

Patent Claims

1. A residual current circuit breaker assembly with multiple protective residual current circuit breakers (final circuit breakers), one for each circuit, upstream of which an additional time-delayed triggering residual current circuit breaker (main circuit breaker) with correspondingly higher trigger current and rated operating current is connected, in which all residual current circuit breakers are incorporated in a shared housing and are completely wired, characterized in that the main circuit breaker (1) has no summation current transformer and the triggering voltage is obtained through the provision of an additional secondary winding (W1, W2, W3 ...) for each of the final circuit breaker summation current transformers and all these windings are connected in parallel to the proper phases or in series, or with the use of only one secondary winding in each case by means of a rectifier; the one half-wave polarity is used for tripping the final circuit breaker and the other half-wave polarity for tripping the main circuit breaker.

2. A residual current circuit breaker assembly according to Claim 1, characterized in that voltage-dependent resistors (4a, 4b, 4c) are located between the external conductors (L1, L2 and L3) and the ground wire (PE) for monitoring the absence of voltage on the ground wire and no neutral conductor circuit breaking contacts are provided for the final circuit breakers.

There are 2 pages of drawings for this

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Drawings Side 1

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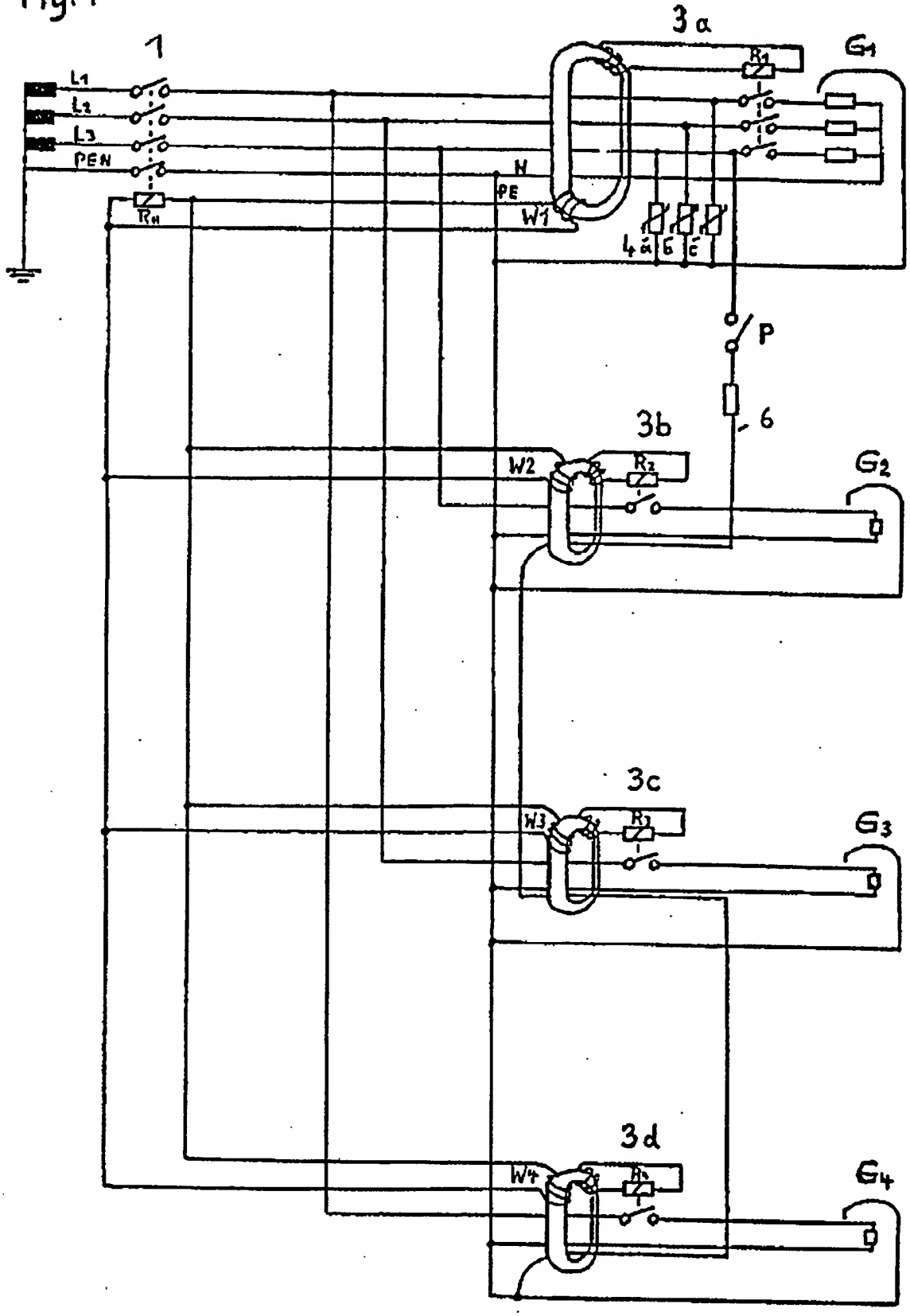
Fig. 1



Drawings Side 2

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Fig. 2